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WHERE ANGELS FEAR TO TREAD: A CONTRIBUTION FROM GENERAL SOCIOLOGY TO HUMAN ETHICS[1]

By Dr. W. C. ALLEE

UNIVERSITY OF CHICAGO

INTEREST in the social impact of science in general and of biology in particular has been growing steadily in the last few decades. The problems imposed by the present war and by thoughts of the coming post-war world have increased this interest. My own active concern with various phases of the sub-social and social life of non-human animals has revealed enough of the complexities of these simpler social systems to make me well aware of my limitations when confronted with the modern social problems of men. It is the drive of immediate necessity rather than a feeling of competence that impels me to undertake the present discussion of the biological foundations for some fundamental phases of the social behavior of men.

[1] Proposed address as vice-president and chairman of Section F of the American Association for the Advancement of Science.

I. THE BIOLOGICAL EVIDENCE

In our laboratory we are making two experimental approaches to the phenomena of biological sociology, and each yields its very different aspect of truth. On the one hand, we have been studying for over a decade the dominance-subordination relations that are characteristic of many social groups. We know from personal observations, as well as from the literature, of nip-orders in fish, peck-orders in flocks of several species of birds and fighting orders in mice. Usually there is one dominant animal which can bite, nip or peck others without being attacked in return. Below it the others are ranked in various degrees of subservience. Similar dominance orders occur among such mammals as rats, cats, cows and men. Social organizations have also been reported with certainty

for turtles and for lizards, as well as for many species of birds and mammals besides those which we have observed.

These social organizations are based immediately on fighting or bluffing ability, on individual aggressiveness or meekness, as exhibited in pair contacts between the different members of the vertebrate group in question. Usually the complete social order within a small group is determined during the first few days of contacts; often, among hens, for example, in the first series of encounters. The order, once established, is not readily upset. With fish, changes occur fairly frequently; but with hens, we have observed the same peck order to persist unchanged for as long as a year, and this is a relatively long time in the life of a hen. These social orders are a real expression of crude, person-against-person competition for social status and furnish fair illustrations of the individualistic, egocentric phase of group biology. Here is an aspect of the individual struggle for existence, and as such it illustrates an important phase of the Darwinian theory of evolution.

High position in the social peck order confers privileges. We know that top-ranking animals feed more freely; that high-ranking males of rhesus monkeys, sage grouse and the common domestic fowl have more ready access to females. Low social status may lead to semi-starvation, to psychological castration among cocks, to ejection from coveys of quail; and among many species it forces the low birds into inferior territories. In some cases, high social rank carries responsibilities for leadership or for guard duty; in other instances no correlation with social duties has been demonstrated as yet. Among others, I have published research reports and discussions of many such relationships and need not dwell on them longer.

These studies of individual aggressiveness make one experimental approach to general and comparative sociology. Our second line of attack comes from a different quarter. For more than twenty-five years we have been experimenting with group-centered tendencies which long before my time were called cooperation. Careful students nowadays point out that, among lower organisms, cooperation is entirely non-conscious. In this phase of our study we are investigating natural cooperation somewhat as many other biologists have been concerned with natural selection. Natural cooperation in its simpler forms implies merely that the interrelations between cells, for example, are more beneficial than harmful for the individual, or that the interrelations between individuals are more beneficial than harmful for the given social group.

I have added to and reviewed repeatedly the modern evidence concerning the existence of such cooperation. Mere repetition does not necessarily make for acceptance, but a good purpose may be served by summarizing in outline form the types of modern evidence that I have found compelling; the details can be filled in from the extensive literature.[2]

(1) At all levels of the animal kingdom, and under a variety of conditions, there is added safety in numbers up to a given point. Animals from the protozoans to insects or man meet many adverse conditions better if optimal numbers are present rather than too few. There is danger also in overcrowding, but I am emphasizing just now the danger of the population being too sparse. For certain animals this sort of mass protection exists when the organisms are exposed to heat. Mass protection from cold is more common, as is protection from many poisons and from other harmful chemicals. Optimal numbers also protect from ultra-violet radiation, from radical changes in osmotic pressure and from many environmental deficiencies.

Macerated cells of a sponge will not regenerate if too few are present and the smallest embryonic grafts frequently fail to grow when somewhat larger ones succeed. If a natural population falls too low, it is in danger of dying out even though theoretically able to persist.

(2) In keeping with the relations just outlined, many organisms, both plants and animals, are able so to condition an unfavorable medium that others following or associated with them can survive better and thrive when they could not do so in a raw, unconditioned medium.

(3) Certain vital processes are adaptively retarded by increased numbers up to a given density. For example, scattered spermatozoa of many marine organisms lose fertilizing power more rapidly than they do when they are massed together.

(4) Other biological processes are accelerated, perhaps beneficially, in the presence of populations of optimal size and density. Such processes are slowed down both in over-sparse populations and in those that are overcrowded. Cleavage rate in Arbacia and certain other eggs follows this rule. Various kinds of Protozoa show acceleration in rate of asexual reproduction with medium rather than sparse population density, and similar phenomena may well have been a forerunner of

(5) The evolution of the cooperative processes which are associated with sexual reproduction.

(6) Colonial protozoa could hardly have evolved from solitary forms unless the simple colony of cells that remained attached after divisions had shown cooperative powers that were lacking when the cells were scattered singly. The evolution of the Metazoa from the Protozoa was probably based on similar relationships.

[2] W. C. Allee, "The Social Life of Animals." 283 pp. New York: Norton. 1938.

(7) Each advance in complexity of metazoan individuals came from the natural selection of an increased ability in natural cooperation on the part of the evolving stock; the greater natural cooperation came first, and then it was selected.

(8) Darwin[3] recognized that a relatively large population is a highly important factor in natural selection. Sewall Wright and others have evidence that evolution proceeds most rapidly in populations of interbreeding organisms that are intermediate in size, as compared with similar populations which are over-small or over-large.

(9) The interdependence of organisms is shown by the repeated observation that all living things, from the simplest to the most complex, live in ecological communities; this is plainly seen in the many biocoenoses, such as those of the oyster bed. Further, the evolution of truly social animals has occurred independently in widely separated divisions of the animal kingdom. These could hardly have arisen so frequently and from such diverse sources if a strong substratum of generalized natural cooperation were not widespread among animals in nature. In nature no animal is solitary throughout its life history.

(10) As with the individual organisms, each advance in complexity of the social life of any group of animals is based on the development of some means of closer cooperation between the individual units of the evolving group.

We have good evidence then that there are these two types of social or sub-social interactions among animals: the self-centered, egoistic drives which lead to personal advancement and self-preservation, and the group-centered, more-or-less altruistic drives that lead to the preservation of the group or of some members of it perhaps at the sacrifice of many others. The existence of egoistic forces in animal life has long been recognized. It is not so well known that the idea of the group-centered forces of natural cooperation also has a respectable history. I take time to give a bare outline of the growth of this idea and to mention some of its proponents because many professional and lay students are interested in the men who have accepted an idea as valid as well as in the evidence that supports it.

The germ of the concept of natural cooperation, along with that of natural selection, can be traced to the biologically absurd poetry of Empedocles about the middle of the fifth century, B.C. Thereafter the principle was kept feebly alive by the succession of thinkers from Aristotle to Herbert Spencer and beyond, who saw human society as a natural outgrowth rather than as an artifact.

More positive emphasis on the "altruistic" interpretation began with the third Earl of Shaftesbury who, about 1700, recognized clearly that racial drives exist which can be explained only by their advantages to the group. He thought that there is a natural goodness about men and recognized that other animals may be kind to associates of their own species. Adam Smith, in his "Theory of Moral Sentiments," wrote in 1759 of the same qualities under the heading of "sympathy" or "fellow feeling." His more famous "Inquiry into the Wealth of Nations" (1776) is based on the opposed forces of self-interest and he did not publicly reconcile the two. Later Comte (1798–1857) emphasized "altruism" as Feuerbach (1804–1872) did "love." These relationships are reviewed sympathetically by Lange (1875) in his remarkable "History of Materialism."

Herbert Spencer argued now for egoism and again for altruism. In 1901 he balanced the two following quotations from his "Principles of Ethics": "If we define altruism as being all action, which in the normal course of things, benefits others instead of benefiting self, then, from the dawn of life, altruism has been no less essential than egoism. Though primarily it is dependent on egoism, yet secondarily egoism is dependent on it."

Darwin, in the "Origin of Species" (p. 215) recognized that evolution within the worker caste of ants can be explained by remembering that selection can act on the family as well as on the individual and Weismann[3a] in 1893 underscored the point. Such ideas are in keeping with Darwin's use of the phrase "struggle for existence," of which he said: (p. 46) "I use this term in a large and metaphorical sense including dependence of one being on another and including (which is more important) not only the life of the individual, but success in leaving progeny."

In the "Descent of Man" (1874), Darwin gave Kropotkin-like naturalistic examples of mutual aid; and we can readily see that Darwin's whole thesis that man is descended from other animals requires that man's altruistic drives have precursors among his animal ancestors. Darwin clearly derives the moral sensibility of man from his "social instinct" played upon by reflective intelligence and states (p. 122): "The term, general good, may be defined as the rearing of the greatest number of individuals, in full vigour and health, with all their faculties perfect, under the conditions to which they are subjected. As the social instincts both of man and the lower animals have no doubt been developed by nearly the same steps, it would be advisable, if found practicable, to use the same definition in both cases, and to take as the standard of morality, the general good or welfare of the community. . . ." He recognized group-focused tendencies in the higher mammals. He did not, as

[3] "Origin of Species," Murray's Library Edition, p. 74.

[3a] August Weismann, *Contemp. Rev.*, 64: 309–338. 1893.

nearly as I can judge, sense the existence of the reservoir of sub-social and social tendencies of which Espinas[4] wrote in 1878.

Geddes and Thompson comment in their book called simply "Evolution" (p. 167), which was published in 1911, that "Darwin's characteristic fundamental idea of the intricacies of the interrelations in the web of life lies below the idea of natural selection." Later, in speaking of family and group selection, they continue: "Though Darwin did not wholly overlook this (indeed in one notable passage he expresses it) there is no doubt that the general tone and treatment of Darwinism, even hitherto, has been colored by the acute individualism of Darwin's and the preceding age."

Evidence that the egoistic emphasis was common in British scientific circles during Darwin's later life, and that group-centered interpretations were novel is found in a news note from *Nature* for January 21, 1880: "We notice an important communication by Prof. Kessler at the annual meeting of the St. Petersburg Society of Naturalists on January 8 [1880] on the 'Law of Mutual Help' as one of the chief agents in the development and progress of organisms. Prof. Kessler, although an able follower of Darwinism, thinks that the struggle for existence would be insufficient to explain progress in organic life, if another law, that of sociability and mutual help, did not powerfully work for the improvement of the organism and for strengthening the species."

Espinas (1878), two years before Kessler's lecture, had given a similar interpretation which he supported by the best observations then available. Espinas emphasized the naturalness of the cooperative, social drives. Geddes and Thompson reaffirmed a similar conclusion in 1911: "We may therefore restate the concluding thesis of our 'Evolution of Sex' (1889) since elaborated in various ways by Drummond, by Kropotkin and others. It is that the general progress both of the animal and plant world, and notably the great uplifts, must be viewed not simply as individual but very largely in terms of sex and parenthood, of family and association; and hence of gregarious flocks and herds, of cooperative packs, of evolving tribes, and thus ultimately of civilized societies. . . ."

The idea did not catch general scientific attention despite the emphasis placed on such an interpretation by Delage and Goldsmith (1912),[5] Reinheimer (1913, 1920), and William Patten, who in 1920 made the cooperative principle the central point in his "grand strategy of evolution." The neglect continues despite the repeated emphasis given by William Morton Wheeler (1923, 1930), despite my own summaries of supporting evidence and the more recent adoption of this point of view by Emerson (1942), Gerard (1942) and others whose opinions should carry weight. Today, as in Darwin's time, the average biologist apparently still thinks of a natural selection which acts primarily on egoistic principles, and intelligent fellow thinkers in other disciplines, together with the much-cited man-in-the-street, can not be blamed for taking the same point of view. Personally, I was well and thoroughly trained in this orthodox biological doctrine. For example, it was clearly stated in the first chapter of a book published in 1913 by my stimulating friend and former teacher, Professor V. E. Shelford.[6]

As was shown earlier, both egoistic and group-centered forces exist in nature and both have been brought under experimentation. I had wondered for years whether we could experimentally test for possible relationships between these two basic phases of animal behavior. Might organized groups of birds, to take one possible instance, have survival values for the group in general as a result of their organization, even though there were no signs of an organized group defense? It will be remembered that such a group organization is based on individual aggressiveness and yields survival values for the high-ranking individuals in the peck order.

I have not yet been able to devise an elegant experiment to test the point. The best one I have been able to think up has been in progress for over nine months. Briefly, we have three flocks of line-bred hens which have been allowed to become organized and are kept as controls. In a similarly housed neighboring flock of the same stock, a new hen is added daily or every second day and the hen which has been longest with the flock is removed and placed in isolation for twenty-one days or more before she is again introduced into the experimental flock. By that time, apparently, she has forgotten all other hens as individuals; hence the experimental flock is in a state of continual reorganization.

I can not take time for details and without them you will be unable to make a critical judgment con-

[4] A. V. Espinas, "Des sociétés animales." 588 pp. Paris. Librairie Ballière.

[5] Y. Delage and M. Goldsmith, "The Theories of Evolution." 352 pp. London: Palmer. 1912. H. Reinheimer, "Evolution by Cooperation; a Study in Bioeconomics." 200 pp. London: Paul, Trench, Trübner and Co., Ltd. 1913. H. Reinheimer, "Symbiosis, a Socio-Physiological Study of Evolution." 295 pp. London: Headley Brothers. 1920. W. Patten, "The Grand Strategy of Evolution." 429 pp. Boston: Badger. 1920. W. M. Wheeler, "Social Life among Insects." 375 pp. New York: Harcourt Brace. 1923. W. M. Wheeler, "Social Evolution." Chapter IV in "Human Biology and Racial Welfare." 612 pp. E. V. Cowdry, ed. New York: Hoeber. 1930. A. E. Emerson, "Basic Comparisons of Human and Insect Societies." Biol. Symposia VIII, 163–177. 1942. R. Gerard, "Higher Levels of Integration." Biol. Symposia, VIII, 67–87. 1942.

[6] V. E. Shelford, "Animal Communities of Temperate America." 362 pp. Univ. of Chicago Press. 1913.

cerning the value of the experiment. An individual can effect the quality of the group life in these flocks; still, despite differences in individuals, the indications are that, regardless of the individuals that may be present, the organized flocks eat more, maintain weight better and spend less energy in fighting, bluffing and pecking each other than is the case with the flock that is daily subjected to reorganization. The strong suggestion is that an organized flock of hens has survival value as a flock which is lacking among an otherwise wholly similar group of hens, that is never allowed to become socially stabilized.

With all its imperfections, the experiment suggests that person to person competition, if not too severe, may lead to group organization which increases the effectiveness of the group as a cooperating social unit in competition or cooperation with other social organizations. Such a conclusion had been suggested by naturalistic evidence. Other data, certain types of which have already been summarized, indicate that cooperation at the individual level may also yield groups with increased competence in competition or cooperation at the group level. Any group organization, however achieved, may be helpful under many conditions. There is suggestive evidence that the relations between individuals which form a simple group of the first order are repeated between such groups when compounded into a unit of a higher social order. Even when society becomes still more complex, the relationships remain essentially similar. Throughout the higher social categories, there may be group-centered egoism and tendencies toward inter-group cooperation at one and the same time.

With cosmopolitan species, whether of human or of non-human animals, in last analysis, the cooperative units tend towards being world-wide in scope. If in its spread over the globe the common house sparrow becomes a new host for a virulent disease organism, the welfare of the whole species may be affected. Sessile eel grass has been devastated on the Atlantic coasts of Europe and of North America by the same mycetazoan parasite. The conclusions that I have been discussing are based primarily on objective studies with non-human animals. They are supported by much evidence from the interrelations of men; and the global scope of the cooperative interests of *Homo sapiens* are more obvious and have more possibilities for development than have those of any other species.

The picture that emerges from the cumulative studies on social biology is one in which cooperations and their opposite, disoperations, both exist. There are both egoistic and altruistic forces in nature, and both are important. The question arises insistently as to which of these is more fundamental and potent. Any such evaluation must be based on both short-run and long-run effects. After much consideration, it is my mature conclusion, contrary to Herbert Spencer, that the cooperative forces are biologically the more important and vital. The balance between the cooperative, altruistic tendencies and those which are disoperative and egoistic is relatively close. Under many conditions, the cooperative forces lose. In the long run, however, the group-centered, more altruistic drives are slightly stronger.

If cooperation had not been the stronger force, the more complicated animals, whether arthropods or vertebrates, could not have evolved from the simpler ones, and there would have been no men to worry each other with their distressing and biologically foolish wars. While I know of no laboratory experiments that make a direct test of this problem, I have come to this conclusion by studying the implications of many experiments which bear on both sides of the problem and from considering the trends of organic evolution in nature. Despite many known appearances to the contrary, human altruistic drives are as firmly based on an animal ancestry as is man himself. Our tendencies toward goodness, such as they are, are as innate as our tendencies toward intelligence; we could do well with more of both.

II. Some Implications

Now I come to the more delicate part of my task. In discussing the further implications of the evidence and conclusions just presented, I am, as much as is possible, speaking in my private capacity as an American citizen with generations of American ancestors. I am both a mature biologist and a working member of a religious organization. The ideas I shall express are not necessarily those of the American Association for the Advancement of Science or of any of its sections; neither are they to be interpreted as the views of the university at which I work or of any other formal or informal organization. If at times I seem to place myself as a spokesman for all scientists or for biologists in general, please remember that I am giving my personal views and am not attempting an authoritative interpretation of the opinions of others.

As I see it, our present-day civilization is based primarily on religion, on other forms of tradition and on science. The arts furnish color and interpret the behavior and thinking of the human participants. Philosophy busies itself, or should, with trying to understand and explain the whole. The functioning of our type of civilization, if it is to be properly effective, calls for the cooperation of all these forces.

To-day, as in the past, religion wastes valuable time and energy quarrelling with science about their relative importance and over the proper division of functions, a quarrel which nowadays scientists largely ignore. Philosophy stages jurisdictional disputes with both. Too often art becomes cynical and irresponsible,

and philosophy scolds all and sundry, sometimes in no friendly voice, for the general unwillingness to let philosophy direct the whole.

Philosophy insists, even yet, on its discredited age-old claim of having a special short cut to knowledge. Particularly philosophy scolds science, the most recently revitalized force in civilization; and modern religion, having attempted to use science to establish its claims, tries to carry on alone in some of the most vital activities of our times.

Here, as elsewhere in human efforts, it is easier for closely knit elements in a situation to develop and react to frictions among themselves than it is to disregard relatively petty internal troubles and make common cause against serious opposing forces. The forces in opposition to the better aspects of our none-too-perfect civilization are strong enough to demand united efforts from the arts, philosophy, science and religion if they are to be properly met. Perhaps plain speaking from a somewhat unorthodox friend of all these elements of civilization may be helpful.

Religion has much to learn from science in objectivity, in willingness and courage to follow evidence fearlessly and even in judging what constitutes valid evidence. Particularly religion can learn from science the advantage of giving up the thundering "thus saith the Lord" in favor of the more humble and essentially more effective summary of "this appears to be the evidence." In short, religion can profit by becoming intellectually more sound without losing for a moment its proper emphasis on the deep emotions of man.

And science has much to learn from religion. I mean from real religion, not from the pseudo-science of theology which, too often, consists mainly of expert verbal manipulations, related to scholasticism rather than to science.

Apparently I must take time to suggest what I mean by religion. Religion is ill-served by past and present emphasis on mystical and supernatural improbabilities. To me "God" is a possibly permissible name for the personification of all the best that the human race has been able to think and do and of all the beauty we have created, together with all the natural beauty we can appreciate. Such a conception transcends tradition and mere emotion and has both power, and dignity. While by no means final, this is as close an approach to the truth as real evidence permits at present.

Science has much to learn from such a religion as I have just outlined, a religion characterized by unselfish living and honest thinking combined with propaganda of the deed. More specifically, scientific men can profit by greater humbleness in the face of our immense ignorance about matters well within our several fields of professed competence. We can also dispense with excessive pride in the usually small discoveries we are able to make.

We scientists can profit by a frank admission of our awe and admiration for the pervading beauty of the phenomena we study, the charm of which often escapes us because of our preoccupation with details. We will profit by being less certain that the more unpalatable the interpretation, the closer the approach to truth. We will gain in the long run by working in our chosen fields more inconspicuously and quietly. Science, and mankind too, will profit by scientists who live closer to the ideals expressed and practised by the more devoted men of science or of religion.

I could make these suggestions in stronger language were it not for the fact that from a fairly wide and close acquaintanceship with many kinds of people, individual exceptions aside, scientists in general and biologists in particular seem the best people I know. This may be an expression of prejudice based on congeniality of temperament. I am inclined, however, to regard the difference between my scientific and my other friends as real and to attribute it to the training furnished by scientific practises.

The biological sciences impose an especially effective discipline in that they combine an impressive amount of precision in detail with a large content of imponderables. The combination is the more effective in that a mistake in judgment concerning the imponderables is usually exposed relatively soon by some precision measurement. The continuous checking of ideas against evidence does something to make conscientious followers of the scientific method essentially more honest and less given to the self-deception, which is one of the weaknesses among those skilled primarily in the manipulation of ideas or of words.

As with followers of other disciplines, we scientists are very human. Our frequent preoccupation with "my status," "my experiment," "my theory," "my priority" and even with "my little bug" is a source of weakness for which correction can be found in a closer approach to the ideals of science or of religion.

Despite my firm belief in the essential goodness of my biological colleagues, I must admit that advanced laboratory study and the introduction to research does not automatically produce some of the higher types of altruism. When recurrent opportunities come to recommend some one to teach biology in a deserving though struggling Negro college, or in remote, ill-equipped, much-needed Chinese or Hindu laboratories, I have learned to turn to students with a strong religious background for men with vision enough to see that the opportunities may, in the long run, repay the sacrifices.

Let us take another approach. No one of us passes much time without being reminded that we are living

in a world at war and in a country that is closely engaged in that war. We went into this present conflict with, on the whole, commendable calm, and the war is being prosecuted more efficiently because wartime emotions are at a minimum as yet. It is questionable how long this frame of mind will continue. Our sons and friends and students are engaged on many fighting fronts and tension mounts as the casualty lists trickle through. We need to examine frequently our responsibilities as biologists in our world to-day, for, like other animals, biologists do not live in a vacuum insulated from the impacts of their time.

It has come as a shock to many that their hard-won biological skills are of so little direct use in the war. The closer the approach to preventative or curative medicine, the greater the immediate applicability of our biological training. It is true that in the war effort there have been some fairly amusing practical applications of highly impractical phases of biology, for it is impossible to predict what bit of pure science of to-day will be the basis for the applied science of to-morrow.

For most, particularly for those of us in the upper-age brackets, we must continue for the foreseeable future at our present jobs or at something closely approximating them. We may need to shift teaching and research somewhat; many have already done so. Primarily, however, our main job must be to remain steadfastly at our usual, routine tasks. These are by no means unimportant even for a world at war. The younger generation needs as many steady points of reference as possible in their rapidly shifting world. This need is tacitly admitted when they come, as they do, to talk themselves quiet in the presence of a sympathetic, calm, older person in whom they place some confidence.

We have a heavy responsibility to our younger friends and students in the armed forces of the world, in the civilian public service camps, in concentration camps or in prisons, so to act that they have a recognizable world to which to return. We, as well as they, have our responsibilities to defend and later to rebuild our civilization, using the techniques we know best. Our phase of the task is as important as it is undramatic.

In the present and immediate future we have the task of helping maintain our forms of government both locally and nationally. Closer home, we have the pressing work of maintaining academic standards and the honesty of academic credits, certificates, fellowship and other awards and even of academic degrees.

In addition to attempting to maintain present levels of competence in intellectual training, we need to give full play to all usable forces that make for emotional stability. Admittedly we are highly ignorant concerning methods for the education of the emotions at the college or graduate level. Mainly we trust to the added stability that comes with maturity. We need to pool our ignorance and attempt positive steps towards training emotion as well as intellect. We have some hints on which to work. Project methods of laboratory study can be helpful as can volunteer summer work camps, honest competitive group sports and many kinds of informal group living. The difficulty of the task and ignorance of how to educate the emotions does not warrant us in continued neglect of this important phase of education.

For the somewhat more remote future, there is an obligation that rests with especial weight on biologists to attempt to make sure that mankind does not lose the peace that will follow this war. We have less hope of winning the peace if all of us become emotionally engulfed in the war. Among other consequences of this duty not to lose the peace, we have an obligation to keep fundamental research projects going even in wartime. I am fully convinced that those nations will have the best opportunity to win the peace who emerge from the present conflict with their program of basic research most nearly intact. This includes the necessity for maintaining a supply of trained research workers in the basic disciplines and the retention of enough of the brilliant younger men to ensure a steady trickle of researches in a great variety of academic fields, many of which are far removed from the immediate war.

Biologists, as their part of the war effort, are searching with almost frantic haste for new techniques for patching up men's bodies and for solving problems of adequate nutrition for ourselves and our associates. This introduces another phase of the relation of science to war that must be faced honestly. Science is the maker and user of gadgets as well as the discoverer of the shadowy outlines of the tools of the future. Science is fighting this war in laboratories all over the world that were built to search impartially for basic evidence, for the truth, as we naively used to say, and for all people, not for one group or another.

The success of scientists in helping to win the war will be used to blame science itself later. When the war is over, the scientists who are now so praised and courted on almost all sides will be told in no uncertain terms, as we have been in the past, that the war itself was all our doing. And there will be insistent calls from many whose motives are not altogether disinterested, for a moratorium on scientific research lest bigger and more destructive wars have to be fought in the future. Such anti-scientists will forget the long series of vicious wars that were fought before science became a major force in our civilization. There will be some truth in the accusation, for biological science is not wholly free from war guilt. This is not only

because we have been the inventors of tools for mass destruction but because we have been responsible for giving interpretations to some aspects of Darwinian theories of evolution that provide a convenient, plausible explanation and justification for all the aggressive, selfish behavior of which man is capable.

Herbert Spencer in 1901 in his "Principles of Ethics" gave a mild statement of this doctrine (p. 189): "But to say that each individual shall reap the benefits brought to him by his own powers, inherited and acquired, is to enumerate egoism as an ultimate principle of biological conduct. . . . Under its biological aspect this proposition can not be contested by those who agree in the doctrine of evolution."

T. H. Huxley[7] asserts the same principle and characteristically steps up the emphasis. In speaking about primitive men and "their less erect and more hairy compatriots," Huxley's statement was: "As among these, so among primitive men, the weakest and stupidest went to the wall, while the toughest and shrewdest, those best fitted to cope with their circumstances, but not the best in any other sense, survived. Life was a continual free fight and beyond the limited and temporary relations of the family, the Hobbesian war of each against all was the normal state of existence." Huxley's general position was that amelioration of this egoistic struggle was a contribution made by "ethical man" despite his animal ancestry. Ernst Haeckel[8] took a wholly similar point of view.

According to this interpretation, the altruistic drives of man are primarily human attributes that arise from the development of sympathies at the human level and are connected with the mass of animal behavior by a very slender stalk. We know, for example, that the aggression of hens high in the peck-order may be modified by individual tolerances towards certain of their subordinates in a manner that strongly suggests human personal preferences. Also it appears that male chimpanzees show a chivalry pattern towards females that are in oestrus. Such modifications of aggressiveness are weak foundations on which to base the idea of a natural drive toward altruism among men. In fact, it is a fairly common interpretation that such altruistic drives as exist are based primarily on some sort of enlightened selfishness.

It is not to be wondered that apologists for human behavior seized on the doctrine so authoritatively set forth, as a proof that man, having descended from other animals, had inherited fighting tendencies which it was almost useless to resist. The natural fate of all was to engage in a physical struggle for existence softened only by slight checks imposed by more or less artificial rules for human conduct.

The biological support for this fatalistic view regarding, among other things, the inevitableness of intra-species human conflict, is now opposed by strong evidence which indicates that the idea of a ruthless struggle for existence is not the whole, or even the major contribution of current biology to social philosophy and social ethics. This newer evidence, which was outlined earlier, does not cast doubt on the existence of the human vices of pride, covetousness, lust, anger, gluttony, envy and sloth and it does not remove indications that they find natural roots in infra-human behavior. The newer findings do strengthen decidedly the older evidence for a biological basis for the human virtues of faith, hope and love and supply renewed indications that men inherited these tendencies too. This strongly suggests that the present high state of development of the seven capital sins just named is mainly a result of man's learned devilishness rather than his inevitable response to inherited nature. On the other hand, we know too that man has been able to enlarge greatly his natural drives toward being godlike.

From such considerations, I insist again that the data of biology, if properly understood, do not furnish sound support for a social philosophy based primarily on the idea that might makes right in interpersonal contacts or in international relations. Those who assert that the whole trend of science is to lend support to the present war system in settling international disagreements are relying on a mistaken, outmoded phase of biological thought to bolster up a much older and unreasoned drive toward conflict. The philosophy that condones war is not based on all the biological evidence or on recent interpretations made in the light of that evidence. Science is indeed largely responsible for designing the tools with which men fight and for undue emphasis even in the recent past on some of the implications of the Darwinian doctrine. Otherwise scientists as such bear only their proportionate share of the responsibility for the misuse man is making of the powers we have discovered and placed in his hands.

When this war does end, the intelligent public should have much to say about the terms of a just and workable peace. Happily there is interest in this subject among responsible biologists and I want to encourage continued consideration of all its complicated ramifications. Such a study will emphasize again the unity of all the forces that make for civilization. For example, certain phases of modern biology furnish a basis of objective evidence for the age-old religious insight that the fundamentals of a just and enduring peace are to be found in a positive ap-

[7] T. H. Huxley, "Evolution and Ethics and Other Essays." 333 pp. (pp. 203–4). Macmillan, London. 1894.
[8] Ernst Haeckel, "Freie Wissenschaft und freie Lehre." 106 pp. (p. 73). Stuttgart. 1878.

plication of the rule: behave towards all others as you would have all others behave towards you.

Speaking for the moment as a humanist, rather than primarily as a biologist (the two points of view are not unduly dissimilar) there are some implications of this ethical rule as applied to the coming peace which I shall outline. It should be understood that the biological drives toward natural cooperation support the general tenor of the following program without favoring this or any other precise formulation of proposed social action.

(1) We are not to look forward to punishment for defeated *peoples* at the close of the present war.

(2) In under-nourished Europe and elsewhere as needed, administer relief according to ability to furnish it and to need only, not according to politics or boundaries.

(3) Set up a world organization which will, in principle from the start, and in detail as much as possible, treat victors and vanquished alike. This implies similar treatment of all peoples with regard to:

(a) Disarmament; if we disarm other nations, we must be willing similarly to disarm ourselves.

(b) International police; if we subject any major portion of the world to the control of an international police force, we, ourselves, should accept a similar control on the same general principles.

(c) Curtailment of sovereignty; national governments of powerful, along with those of weak peoples, must discontinue the present policy of determining their own actions in all matters deemed by themselves to lie within the limits of their own national interests.

(d) Educate all alike for the processes that make for change by the use of peaceful, non-violent techniques. All nations and many classes within nations do and will continue to need such education for a long time to come.

(e) Behave towards the defeated peoples from the outset more as the English treated the Boers or the United States treated the Filipinos at the turn of the century rather than as our carpet-bag governments coerced the South after 1865 or as England governs troublesome India; and by all means not as Nazi Germany has treated her victims.

We should not overlook the existence of strong, competitive, egoistic drives among all animals, ourselves included. These must be duly considered in any workable plan for a world order. Our job is to keep them in their true place, somewhat subservient to the even more fundamental cooperative, altruistic forces of human nature. They should not again be allowed to steal the international show. These competitive urges can serve mankind well if turned to their original function of driving man in his struggle against his enemies among other species of living things. This struggle is on a global scale, and the members of all countries and races can unite in it. Each can compete against the others for racial, national or personal preeminence in this common task. Competitive drives for worthy ends have real strength. I have only to mention the word priority to a biological audience to make the point.

Consideration of these egoistic drives brings us back again to the hen coops from which we started. Man, like so many of his fellow vertebrates, has a strong tendency to set up social orders among individuals and between groups. In the past, man has made repeated trials of informal and finally of a more formal world organization based on dominance and subordination. There have been the hen-like peck orders of the early world empires to which the atavistic Nazi system is an attempted return. Until recently these rigid peck orders were being replaced by the more democratic dovelike give and take of territorial orders, in which, certain empires aside, each nation had the peck-right over all comers in its home territory. With nations, as with many territorial birds, when space became crowded, the dove-like peck dominance changed to the more despotic peck right.

To-day, a major biological contribution to the discussion of a post-war world is that, solidly as the peck-right system is grounded in animal behavior, it is not the only pattern for human action that biology has to offer. Other animals show a somewhat stronger tendency toward essential cooperations than they do toward struggles for egoistic power. Man can, if he chooses, focus on his innate drives toward cooperation and attempt to set up a new order based primarily on some altruistic pattern such as I have outlined. The task will be easier since modern biological teachings in these matters resemble many of the social doctrines of the ethical religions.

The difficulties in the transition from the power politics of the international peck order to a system based on international cooperation are impressive. The change is possible. If the attempt is deferred for the present, it will most certainly come in the future and I prefer to start toward the future now. If we again turn toward the solutions of the past, we face the disheartening certainty that power politics have never avoided war for more than a few decades and will not avoid war again. We are aided in working toward a more rational goal by the fact that, one or two nations aside, there is a general and strong mind-set toward peace throughout the peoples of the world. Our task as biologists, and as citizens of a civilized country, is a practical engineering job. We need to help arrange so that the existing trend toward a workable world organization will be guided along practical lines which accord with sound biological theory. And we must remember always that in such matters the idealist with the long-range view is frequently the true realist.

OBITUARY

RECENT DEATHS

DR. WILLIAM FRANCIS MAGIE, Joseph Henry professor of physics at Princeton University from 1890 until his retirement with the title emeritus in 1929, dean of the faculty from 1912 to 1925, died on June 5. He was eighty-four years old.

DR. CHARLES F. MARVIN, who retired in 1934 after serving as chief of the United States Weather Bureau for twenty-one years, died on June 5 at the age of eighty-four years.

WESLEY P. FLINT, chief entomologist of the Illinois State Natural History Survey and of the College of Agriculture of the University of Illinois, died on June 3 at the age of sixty-one years.

DR. MARION A. AMES, professor of chemistry and chairman of the Division of Natural Sciences at Elmira College, died on June 4. She was forty-four years old.

EDWIN M. BAKER, professor of chemical engineering at the University of Michigan, died on May 26 at the age of fifty years.

MILNOR R. FREELAND, since 1930 resident chemist at the Presbyterian Hospital of Chicago, died on May 4 at the age of forty-two years.

DR. JOHN W. RITCHIE, science editor of the World Book Company, formerly professor of biology at Maryville (Tenn.) College and the College of William and Mary, Williamsburg, Va., died on May 29 at the age of seventy-one years.

The Cleveland Clinic Quarterly dedicated its April issue to the memory of the late Dr. George Crile, a founder and former president of the Cleveland Clinic Foundation, and prints the addresses that were presented at the memorial service for Dr. Crile at Western Reserve University on January 24.

THE Council of the American Mathematical Society has adopted the following resolution on the death of Professor E. R. Hedrick: "The Council of the American Mathematical Society records its deep sense of loss in the death on February 3, 1943, of Earle Raymond Hedrick. As an active member of the society during four decades of its unprecedented growth and development, he made contributions which were great in number and varied in character. He gave abundantly of his time, thought and energy to the society and served it in the official capacities of council member, trustee, vice-president, president and editor-in-chief of the *Bulletin*. Through membership on many important committees both within the society and outside of it, he labored unceasingly toward the advancement of the interests and prestige of mathematics at all levels. His activities in the Mathematical Association of America, the National Council of Teachers of Mathematics and in numerous engineering and other scientific societies were extensive and outstanding to a degree hard to comprehend in view of his heavy involvement in society and other responsibilities. Professor Hedrick had a rare combination of broad interests, outstanding skill at logical and thorough analysis, good judgment and ability to work effectively with other people. These characteristics invariably singled him out and placed him in a position of leadership."

SCIENTIFIC EVENTS

AVALANCHE RESEARCH IN SWITZERLAND[1]

DURING the War of 1914–18 the number of avalanche fatalities among the armies in alpine regions was very high; in the period between the two wars, the influx of winter visitors to the Alps was followed by an alarming increase in accidents due to inexperience in snow-craft. It became obvious that a proper study of snow and avalanches was needed. There followed the private research work of individuals in many parts of Central Europe, who in turn were succeeded by more elaborately organized groups. In 1934 the Swiss authorities inaugurated a small research laboratory on the Weissfluhjoch close to the upper end of one of the Davos funiculars at a height of 8,500 feet. Under the direction of Dr. H. Bader, a crystallographer, and Dr. M. Haefeli, a civil engineer, much valuable work was carried out ranging from the purely scientific to the severely practical. The former has given us a great deal of new knowledge of the structure and behavior of ice crystals, such as their rearrangement into regular order under stress with its clearly defined metallurgical analogy. Among the latter were such tests as the reaction of different types of snow to varying meteorological conditions and the resulting tendency to increase or decrease avalanche danger. The drawing together of the many threads of research followed and the results, combined with the investigations of practical men in the mountains, have been of the greatest value in bringing about a closer understanding of, and so mitigating, avalanche dangers. An excellent publication of some 340 pages was produced in 1939 recounting the field and laboratory work up to the end of 1938, and subsequent publications have also appeared.

[1] From *Nature*.

Originally the governing body of the Weissfluhjoch station was the Swiss Commission for Snow and Avalanche Research under the chairmanship of the head of the Federal Forestry Department and working in conjunction with many Swiss men of science, chief of whom was Professor P. Niggli, the mineralogist, of Zurich, and including many experts in cognate subjects such as Dr. Mörikofer, of the Meteorological Observatory at Davos. It was largely financed from unofficial sources. A recent press notice stated that the Swiss Government has opened a new research institute on the Weissfluhjoch, which is assumed to be a development of the earlier laboratory, perhaps more on the lines of the research institute on the Jungfraujoch. Possibly it means the commencement of its existence as a separate department of the Ministry for the Interior, with more adequate funds for effective research than its semi-private forerunner had been able to command.

THE TROPICAL PLANT RESEARCH FOUNDATION

THE Board of Trustees of the Tropical Plant Research Foundation met in Washington, D. C., on May 21, for the purpose of dissolving the foundation and distributing its assets to other organizations that are now carrying forward the avowed functions of the foundation. They also authorized and directed the officers of the corporation to institute proceedings in the United States District Court of the District of Columbia for the dissolution of this corporation as allowed and provided for by law.

The distribution of assets were as follows: (1) The Tropical Agriculture Library now housed at the Boyce Thompson Institute, including all copyrights, was given to the Inter-American Institute of Agricultural Sciences of Turrialba, Costa Rica. This is to be dedicated and marked with an appropriate plaque as a memorial to Dr. W. A. Orton, the organizer and director and general manager of the foundation from its inception in 1924 until his death in 1930. (2) Fifty copies of "The Soils of Cuba," including the accompanying maps, were given to each of the joint authors, H. H. Bennett and Dr. R. V. Allison. Fifty copies of "Tropical Forests of the Caribbean" were given to the author, Tom Gill. The remaining copies of these books, about 550 of the former and about 225 of the latter, were turned over to the Pan American Union to be advertised and sold. The returns from these sales are to be turned over to the Division of Biology and Agriculture of the National Research Council or to some other appropriate organization to be used to further tropical agriculture. (3) All residual cash and bonds, after payment of debts and expenses of dissolution, were given to the Division of Biology and Agriculture of the National Research Council to be used for the promotion of tropical agriculture. This contribution will net about $4,500. (4) The furniture, bookcases, steel cabinets, etc., are left to the Boyce Thompson Institute for Plant Research, Inc., Yonkers, New York, in appreciation of services rendered the foundation during the period following Dr. Orton's death.

WILLIAM CROCKER,
Acting Director and General Manager,
Tropical Plant Research Foundation

THE INDUSTRIAL RESEARCH INSTITUTE

THE Industrial Research Institute completed five years of activity with its recent annual meeting in New York on May 21 and 22. Seventy industrial executives and research directors, representing member companies, and their guests attended the meeting and participated in informal round-table conferences.

The organization of research in Great Britain and the United States, its support of the war effort and probable post-war trends, was discussed at the dinner session on the evening of May 21. Dr. G. S. Whitby, professor of rubber chemistry at the University of Akron and recently director of the chemical research laboratory of the Department of Scientific and Industrial Research, Teddington, England, presented the British picture, and Dr. Robert W. King, assistant vice-president of the American Telephone and Telegraph Company, discussed the situation in this country. Dr. Whitby explained the basic differences in the organization and effectiveness of research in Britain and the United States.

At a session on new research tools Dr. G. W. King, of Arthur D. Little, Inc., discussed improved calculating machines for scientific use, particularly in the field of chemistry. Dr. W. B. Rayton, director of the Scientific Bureau of Bausch and Lomb Optical Company, described new optical tools and their applications in various fields of industrial research.

Other sessions were devoted to discussions of industrial research management problems. R. C. Benner, director of research, and G. J. Easter, assistant director of research of the Carborundum Company, described a simple system which has proved of great help in the current control of research projects. It is based on the budgeting of time rather than money. Cooperative intra-industry research in seventeen industries represented in the institute was reviewed by J. M. McIlvain, administrative supervisor of the Research and Development Department of the Atlantic Refining Company.

The rating of research personnel was discussed in four simultaneous group conferences on Saturday morning, under the leadership of C. L. Bausch, vice-

president, Bausch and Lomb Optical Company; J. N. Dow, technical director, Bigelow-Sanford Carpet Company, Thompsonville, Conn.; R. S. Taylor, chief engineer, Servel, Inc., Evansville, Ind.; and H. L. Trumbull, assistant to the director of research, the B. F. Goodrich Company, Akron, Ohio.

William R. Hainsworth, vice-president of Servel, Inc., New York, was elected chairman of the executive committee for the ensuing year, and Harold K. Work, manager of the Research and Development Division, General Metallurgical Department of the Jones and Laughlin Steel Corporation, Pittsburgh, was elected vice-chairman. Three new members of the committee were also elected for three-year terms: A. Griffin Ashcroft, product engineer of the Alexander Smith and Sons Carpet Company; Ralph T. K. Cornwell, director of research of the Sylvania Industrial Corporation, and John M. McIlvain. It was announced that the fall meeting of the institute will be held in Chicago.

The Industrial Research Institute, an affiliate of the National Research Council, undertakes to promote improvement of methods and more economical and effective management in industrial research through the cooperative efforts of its members. The membership is composed of fifty-five industrial concerns maintaining research laboratories. Their key executives in charge of research represent them in the activities of the institute. It has headquarters at 60 East 42nd Street, New York. Other members of the executive committee are: Harvey S. Benson, administrative engineer, United Shoe Machinery Corporation, Beverly, Mass.; Maurice Holland, member at large, Division of Engineering and Industrial Research, National Research Council, New York, and Philip W. Pillsbury, president, Pillsbury Flour Mills Company, Minneapolis.

THE MOBILIZATION OF SCIENCE

THE North Carolina Academy of Science has addressed the following letter to members of the United States Senate:

To the Members of the United States Senate

GENTLEMEN:

The North Carolina Academy of Science through its Legislative Committee wishes to call your attention to their action as regards the Senate Bill 702 "A bill to Mobilize the Scientific and Technical Resources of the Nation, to Establish an Office of Scientific and Technical Mobilization, and for Other Purposes."

This Bill would make another expensive and overlapping Office in the Federal Government. It would add confusion. It would not help in the War Effort. It would not help in the Peace to come.

Therefore be it Resolved:

That the North Carolina Academy goes on record as opposing the passage of Senate Bill 702 as said bill would serve no useful purpose.

Signed for the Academy by the Legislative Committee,

WILLARD BERRY, *Chairman*
B. C. BURGESS
H. F. PRYTHERCH
B. W. WELLS

ABBOTT LABORATORIES FELLOWSHIPS

ABBOTT LABORATORIES has announced that its plan of postgraduate fellowships for research in organic chemistry and in biochemistry will be continued for the academic year 1943–44. These fellowships are to aid capable graduate students in continuing their studies. There are no restrictions as to the professor under whom the work is to be done or the subject to be undertaken. The stipend is $750 per year. For the coming year the fellowships are available to both men and women.

The universities to whom these fellowships have been awarded are as follows:

In organic chemistry:
University of California
University of Illinois
University of Michigan
University of Minnesota
Purdue University
University of Rochester
Stanford University

In biochemistry:
Duke University
Iowa State College

It is believed that this aid for graduate study in chemistry will lend encouragement to the continuous training of able and qualified chemists to fill future positions in the educational field and in industry.

GRANT TO THE UNIVERSITY OF MICHIGAN FROM THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

THE National Foundation for Infantile Paralysis and the University of Michigan have joined in a long-range program for the training of doctors, public health workers and laboratory technicians to study infantile paralysis and other virus diseases. This program, which has been developing for three years, will be expanded when the university opens its new three-story building for the School of Public Health.

The new structure will house a unit devoted entirely to work in virus diseases, particularly infantile paralysis. The virologists who will be trained under the program will study all virus diseases, including not only infantile paralysis, but also influenza, atypical

pneumonias, St. Louis and equine encephalitis, measles, chickenpox, smallpox and mumps.

To aid in the necessary planning and execution of the project, the National Foundation has made a three-year grant, amounting to $120,000, to the university. This is in addition to three previous grants amounting to $110,000, made during the past three years. This makes $230,000, which the foundation has made available to the School of Public Health of the university since May 13, 1940, when the first steps in the program were planned by Basil O'Connor, director of the foundation, and Dr. Henry F. Vaughan, dean of the School of Public Health.

President Alexander G. Ruthven made a statement in which he pointed out that, even though the school has not had adequate facilities during the two years since it opened, it has made several outstanding contributions to our knowledge of how the disease is transmitted and on other epidemic diseases in the army and in vital war industries. In addition, twenty men and women have received training in virology during that period.

This is the first time in the history of the National Foundation that three long-term grants have been made within the space of a single year. In April a five-year grant of $150,000 was made to Yale University to permit it to reorganize its work on infantile paralysis and establish the Yale Poliomyelitis Study Unit. Last summer a five-year grant of $300,000 was made to the Johns Hopkins University to establish and conduct a Center for the Study of Infantile Paralysis and Related Virus Diseases.

HONORARY DOCTORATES CONFERRED BY COLUMBIA UNIVERSITY

THE doctorate of science was conferred by Columbia University on June 1 at its one hundred and eighty-ninth commencement on Dr. Charles F. Kettering, vice-president of the General Motors Corporation, and on John Van Nostrand Dorr, president of the Dorr Engineering Company. The doctorate of laws was conferred on William Church Osborn, president of the Metropolitan Museum of Art. The citations by President Nicholas Murray Butler read:

Charles Franklin Kettering: Who for some forty years as engineer and as inventor has contributed in many important ways to human comfort and human safety, particularly in the field of transportation; an outstanding representative of the applied science of our time.

John Van Nostrand Dorr: Graduated at Rutgers University, from which he entered upon a long and most useful career as engineer, inventor and administrator in the fields of metallurgical, sanitary and chemical engineering, with results which have been of exceptional service to the American people and their industries.

William Church Osborn: Graduated at Princeton University when it was under the historic presidency of Dr. McCosh, accepting at once the full responsibilities of good citizenship and continuing to serve the public interest year by year, well illustrating the saying of George Eliot that service done by willing and discerning souls is a glory; now president of the Metropolitan Museum of Art, one of the great art collections in this modern world.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM D. COOLIDGE, vice-president and director of research of the General Electric Company, has been awarded the "Order del Merito" of Chile for his "many services to civilization."

AT a recent meeting of the Royal College of Surgeons of England, the president, Sir Alfred Webb-Johnson, admitted two new honorary fellows, Colonel Elliott C. Cutler, Moseley professor of surgery at Harvard University and chief surgical consultant to the United States Army in the European theater of operations, and Professor W. G. Penfield, professor of neurology and neurosurgery at McGill University.

DR. OTIS W. CALDWELL, general secretary of the American Association for the Advancement of Science, who has been a member of the New York Botanical Garden since 1920, has been voted a life member by the executive committee of the Board of Managers in recognition "of his many services to botanical science and to this Botanical Garden over a long period of years."

THE American Association of Industrial Physicians and Surgeons has awarded the Wm. S. Knudsen Medal for "the most outstanding contribution of the year to industrial medicine" to Dr. William A. Sawyer, medical director of the Eastman Kodak Company. The award was made in recognition of his "work in control of tuberculosis, constructive contributions to a practical program of nutrition in industry and setting up a program of rehabilitation for handicapped workers in industry."

DR. CHARLES KENNETH LEITH, professor of geology at the University of Wisconsin, now head of the metals and minerals branch of Production Research and Development of the War Production Board, received the honorary degree of doctor of science at the commencement exercises of Stevens Institute. Dr. Leith gave the commencement address.

THE Medical School of Tufts College conferred at commencement the honorary degree of doctor of laws on Dr. Lewis H. Weed, professor of anatomy at the

Johns Hopkins University School of Medicine and chairman of the Division of Medical Sciences of the National Research Council. Dr. Weed delivered the convocation address. He spoke on "War Research in Medicine and Dentistry."

DEPAUW UNIVERSITY conferred at its commencement on May 16 the honorary doctorate of science on Dr. Harlan H. York, professor of botany at the University of Pennsylvania.

MAJOR GENERAL RALPH ROYCE, commander of the First Air Force, on June 5 received an honorary doctorate of engineering from the Michigan College of Mining and Technology.

AT the annual dinner meeting and ladies' night of the Branner Geological Society, which was held on May 26 at the California Institute of Technology, the following officers were elected for the coming season: *President,* Herschel Driver, of the Standard Oil Company of California; *Vice-president,* Robert W. Webb, of the department of geology of the University of California at Los Angeles; *Secretary-Treasurer,* Vincent W. Vandiver, of the Seaboard Oil Company. Retiring officers are Wayne Galliher, of the Barnsdall Oil Company; W. C. Putnam, of the department of geology, University of California at Los Angeles, and Clement D. Meserve, of the department of geology, Glendale Junior College. The speaker of the evening was Dr. Beno Gutenberg, professor of geophysics at the California Institute of Technology, who delivered an address on "The Structure of the Earth."

THE anniversary meeting of the members of the Royal Institution, London, was held on May 1 with Major Charles E. S. Phillips, secretary and vice-president, in the chair. The annual report of the visitors was received and adopted, and the following officers were elected: *President,* Lord Eustace Percy; *Treasurer,* Sir Robert Robertson; *Secretary,* Major Charles E. S. Phillips.

DR. S. L. MACINDOE has been elected president of the New South Wales Division of the Australian Association of Scientific Workers. F. Milthorpe is secretary of the division.

BRIGADIER GENERAL JAMES S. SIMMONS, chief of the Division of Preventive Medicine in the Office of the Surgeon General, has been appointed visiting lecturer in public health for the coming year by the School of Medicine of Yale University.

AT the Cornell University Medical College, Dr. McKeen Cattell, who has been a member of the staff since 1924, has been appointed professor of pharmacology and head of the department. Dr. John M. McLean has been promoted to a professorship of clinical surgery (ophthalmology).

DR. JOHN GODWIN DOWNING has been appointed professor of dermatology at the School of Medicine of Boston University and head of the department of dermatology.

DR. A. C. CHIBNALL, professor of biochemistry at the Imperial College of Science and Technology, South Kensington, has been elected to the Sir William Dunn professorship of biochemistry of the University of Cambridge in succession to Sir Frederick Gowland Hopkins.

DR. E. D. HUGHES, lecturer in chemistry at University College, London, has been appointed professor of chemistry at the University College of North Wales at Bangor.

DR. J. ALLEN SCOTT, associate director of the Division of Malaria and Hookworm Service of the Georgia Department of Public Health, has resigned to accept an appointment as senior statistician of the Division of Vital Statistics, U. S. Bureau of the Census, Washington, D. C.

DR. FREDERICK MACCURDY, professor of hospital administration at Columbia University and director of the Vanderbilt Clinic of the Columbia Presbyterian Medical Center, has been appointed New York State Commissioner of Mental Hygiene.

A. C. HOFFMAN, formerly agricultural economist of the U. S. Department of Agriculture and now director of the Food Price Division of the Office of Price Administration, has been appointed assistant to the Deputy Administrator for Price. He will be succeeded in his former post of director of the Food Price Division by R. B. Heflebower, who has served with the Office of Price Administration for approximately a year, first as state price officer for Idaho and more recently as special assistant to the deputy administrator on assignment to the Denver Regional Office.

DR. CARL A. FRISCHE has been named chief research director of the Sperry Gyroscope Company. He will assume charge of the laboratory at Garden City, L. I., which employs more than 1,500 technicians for the design, development and test of military, marine and aircraft precision instruments.

H. N. RILEY, director in charge of research and quality control of the H. J. Heinz Company of Pittsburgh, has been elected vice-president of the company.

DR. CHARLES HANES, F.R.S., has been appointed director of food investigation in the British Department of Scientific and Industrial Research.

DR. ARTHUR H. SMITH, of the department of physiological chemistry of Wayne University College of Medicine, gave the Sigma Xi address at the annual

initiation of the Chicago Colleges of the University of Illinois Chapter on May 21. The subject was "Nutrition—A Factor in National Effort."

DR. ALEXANDER SILVERMAN, head of the department of chemistry of the University of Pittsburgh, gave a radio broadcast on "Glass Goes to War" over Station WGY, Schenectady, N. Y., on June 9.

THE two hundred and fifty-fifth meeting of the American Physical Society will be held at State College, Pennsylvania, on June 18 and 19. There will be a symposium on "Physics in War Training Programs." At twelve noon a lecture on Cosmic Rays will be given by Professor W. F. G. Swann of the Bartol Foundation. At 2:30 P.M. there will be a symposium on "The Role of Physics in the Post-War Period." The program continues through Saturday with invited papers concerning Chemical Analysis by Physical Methods and with contributed papers. The American Association of Physics Teachers holds a meeting which begins with contributed papers on June 18 at 7:30, and continues throughout the following day. The dinner of the societies is set for Friday evening, and will be followed by a lecture by Dr. F. C. Whitmore on "Organic Chemistry for Physicists."

A MEETING was called by the Nutrition Foundation on May 27 in New York City to discuss normal ideas of food preservation and distribution which are being revolutionized by the war, and how the cooperation of food and research laboratories with specialists in nutrition is essential to meeting these new problems. Dr. Charles Glen King, scientific director of the Nutrition Foundation, presided at the meeting, at which sixty research and technical directors of food companies were present, as well as representatives of the government.

THE seventh annual Huntington College, Ind., Botanical Garden Day meeting was held early in May. The address for the occasion was given by Dr. Truman Yuncker, of the department of botany of DePauw University. He gave some of his botanical experiences in the South Sea Islands where he studied for a year. The Huntington College Botanical Garden is now in its eighth year and has six hundred and seventy-one living species all of which have been moved into the garden from various habitats in the central states.

THE late Edsel Bryant Ford, only son of Henry Ford, left the major part of his stockholdings in the Ford Motor Company to the Ford Foundation, incorporated in January, 1936, for the purpose of receiving and administering funds for "scientific, educational and charitable purposes, all for the public welfare." The value of the estate is estimated at $200,000,000.

THE library of the late Professor Franz Boas, a collection of nearly 5,000 volumes and 10,000 reprints, which is particularly rich in early works on anthropology, has been acquired by Northwestern University.

THE American Standards Association has announced the publication of its new "List of American Standards" which will serve as a useful reference to the engineering and purchasing departments of manufacturing firms. More than six hundred standards are listed, ninety-four of which represent new and revised standards approved since the last issue, which appeared in August, 1942.

QUARTZ crystals are needed by the Miscellaneous Minerals Division of the War Production Board for the manufacture of quartz oscillator plates used in radio equipment for the armed forces. At present practically all the quartz used for this purpose comes from Brazil. Only separate individual crystal-clusters are wanted. Each crystal must weigh at least half a pound, be at least an inch thick and three inches long. It must be clear and colorless on the inside, although light smoky quartz can be used. Milky quartz, rose quartz and purple quartz (amethyst) are useless. Citizens who may own property on which such material may be found are requested to get in touch with the Division, Temporary "R" Building, Washington, D. C. If samples can be provided at the same time, they will be welcome. There should be several samples of the best crystals obtainable from each location.

IT is reported that investigation on certain aspects of nutrition in Great Britain is at present handicapped by lack of cooperation. In view of the importance, at the present time, of a thorough knowledge of the state of nutrition in Great Britain, the Nutrition Society has accordingly set up a Committee on Nutrition Surveys, with Sir Joseph Barcroft as chairman; the terms of reference are the coordination of nutrition surveys dependent on (*a*) clinical, physiological and biochemical examinations of human subjects, (*b*) examinations of food budgets, and (*c*) chemical analyses of food and meals (including collective meals). The committee will put investigators in touch with others who are working on the same lines or would cooperate; it will supply information, recommend methods and make periodical summaries of the results of investigations. It has the support of the Ministries of Health and of Food and cooperation of the Services. Professor J. R. Marrack has been appointed as a director serving under the committee.

Nature writes: "Professor A. V. Hill, in a debate on Colonial affairs in the House of Commons, gave his powerful aid to recent pleas for the active support and cooperation of the universities of the British Empire in the advance of Colonial education. He recalls

the opportunity for their active participation in the training of the body of teachers and scientific and professional men that the Colonial peoples so greatly need, and must provide as rapidly as possible from their own ranks. He suggests not only taking a mission—with a harmonium rather than a big drum—around the universities to enlist their active contribution, but also the establishment of a central organization of some kind to watch over the needs of the higher education of Colonial peoples, and to bring their needs and the opportunities these offer continually to the notice of schools, universities and learned societies at home."

THE British National Trust has acquired nine hundred and fifty acres of land at Avebury for the nation. The purchase includes the greater part of the group of prehistoric remains that make this one of the most important archeological sites of Europe.

THE Library of Congress has acquired a microfilm of *Khimicheskii Referativnyi Zhurnal* (chemical abstracts journal) for the years 1938 to 1941 (Volumes 1–4, No. 9) except for No. 4, 1939, and No. 12, 1940. This publication contains abstracts of scientific material published exclusively in the U. S. S. R. The microfilm is available for consultation in the Microfilm Reading Room of the Library of Congress or positive prints may be obtained from the Library of Congress Photoduplication Service.

ACCORDING to a Reuter dispatch from London, Sir Isaac Newton's library has been sold to the Pilgrim Trust. The library consists of 858 volumes, nearly all in contemporary calf bindings. The most important items are first and second editions with many corrections in Newton's handwriting. A number of the books have Newton's autograph signature. The destination of this collection has not been announced. Some months ago the Pilgrim Trust bought the Newton birthplace for the nation.

DISCUSSION

SCIENCE AND WAR

IN SCIENCE (Vol. 97, p. 485), Professor R. A. Millikan attempts to refute the argument that the physical sciences are largely the offspring of war and in so doing makes statements to which scholars who have devoted their lives to the history of science and technology will probably object.

There is no acceptable proof that "gunpowder was invented and first used only for peaceful purposes about 880 A.D." Professor George Sarton has studied all the original sources of information and concluded that gunpowder first appeared toward the close of the thirteenth century either in Syria or western Europe. Moreover, it was used in incendiary and explosive hand grenades soon after its invention.

Professor Millikan maintains that the application of artillery "first began on a serious scale about 1800 A.D." Cannon and muskets were so effective by the sixteenth century that they were rapidly displacing the long bow and other feudal equipment. Sombart goes into this matter thoroughly in his "Krieg und Kapitalismus."

To insist that the discovery of the principles of Galilean-Newtonian mechanics "had nothing whatever to do with war" is to fly in the face of the facts. All the physicists of the Renaissance were inspired by military problems. Newton and Galileo were much concerned with ballistics. The historic evidence that both were strongly influenced by military and naval considerations has been gathered and weighed by B. Hessen in "Science at the Crossroads." His interpretation is widely accepted.

Professor Millikan's statement that science flowered with exceptional vigor from 1814 to 1914, one of the few relatively peaceful periods in European history, ignores the fact that every country was then preparing for possible war, that standing armies were increasing in numbers and that military and naval technology were brought almost to their present pitch of perfection. It was in this period of armed peace that we had such developments as battleship armor, built-up guns, machine-guns, high explosives, coal-tar chemistry (closely linked with explosives), the reduction of nitrogen from the atmosphere (for military purposes primarily), aviation (encouraged for military reasons by every power) and the beginning of synthetic rubber (developed by the Germans in view of an inevitable blockade).

In considering this period Professor Millikan ignores "derivative problems," as Professor Robert Merton calls them, that is, such problems as the expansion and compressibility of gases, strength of metals, rates of combustion of powders, resistance of the air to projectiles and a host of others which were presented by explosives and which received the attention of physicists to the advantage of both war and science. Professor Millikan seems to imply that because the research scientist may be unaware of social pressure he remains immune to it. But the pressure is there and can not be avoided.

It is difficult to see that Professor Millikan proves anything by saying that "the average span of life ... is about sixty years, whereas only 150 years ago it was about thirty years." Soldiers benefit from advances

in medicine and sanitary organization as much as do civilians. A good deal of medicine and hygiene came out of war.

The relation of science to war is not easy to disentangle from a complex of factors, such as the downfall of feudalism, the Reformation, the rise of liberalism and democracy and hence of "high capitalism" and the trader. But the evidence collected by specialists indicates plainly the pressure that the exigencies of war have exerted upon physical scientists.

The effect of war on technology is especially clear. There is not the slightest doubt that the blast-furnace, the coke-oven, the steam-engine, machine-tools and the heavy chemical industry came directly out of military necessity with the introduction of firearms. Here the researches of such scholars as Merton and Werner Sombart are authoritative.

The branches of biology which have made most progress are agriculture and medicine, and the relation of both to war has been brought out time and time again. Moreover, it is significant that the biological sciences as a whole lag behind the physical sciences for the reason that military advantage and profits lie in chemistry, physics and engineering but not in the study of life.

Lastly, there is the remarkable fact that the Chinese, on the whole a stable and pacific people with a culture that has come down intact from ancient times, long made no military use of gunpowder, though they were familiar with it for centuries. As technicians and craftsmen they were in no way inferior to their European contemporaries until the arrival of the Jesuits. Much of the Taoist doctrine of non-action and non-violence must have sunk into the masses. It is significant that in Europe, where gunpowder was used in war, science leaped forward with the introduction of cannon, whereas in China, where gunpowder was used only in pyrotechnics, experimental science was not developed. At any rate it is clear that social influences can not be disregarded in tracing the history of science. And the social influences in Europe have always been chiefly military and economic, with war and economics evolving hand in hand.

WALDEMAR KAEMPFFERT

AREA FIGURES FOR UNITED STATES AND GREAT LAKES STATES

IT will be a surprise to practically every one to realize that the leading reference books of the world give the total area of the United States some 61,000 square miles less than it actually is; the State of Michigan some 40,000 square miles less; Wisconsin about 10,000 square miles less; with similar though lesser diminution of the total area figures for all the other Great Lakes States.

These errors are due to the practice of computing the total areas as if the northern boundary of the United States, which is also the northern boundary of each of the Great Lakes States, were the southern shoreline of the Great Lakes; whereas the international line through the Great Lakes region has nothing whatsoever to do with shore, channel or even presence of water, but is as definite and fixed in perpetuity as the 49th parallel.

Publishers of various reference books, when advised of these inaccuracies, reply that they are quoting the official figures of the U. S. Bureau of the Census.

The Bureau of the Census, in its area table, has an outright error in the total area of the United States. The same tabulation, by its misleading manner of presentation of the facts concerning the total areas of the Great Lakes States, has given rise and authority to the currently quoted total area figures for those states, which are incorrect.

Former Director Austin of the Census Bureau saw these mistakes—which have been of long standing—and agreed to correct the misleading method of presentation in the Census of 1940. After a change of directorship was made, the decision was reversed.

The Bureau of the Census refused to revise its manner of presentation (1) for its own statistical convenience; and (2) because it wishes not to arouse sea-coastal states which advance uncertain claims for strips of ocean water of varying width. For these two reasons it prefers to disregard the fact of absolute ownership by the United States and the Great Lakes States of the American portion of the Great Lakes, and continues to treat this part of the United States as if it were the high seas.

In final extenuation of their attitude, the Director of the Census has advised: "I call your attention to the fact that *land and water areas shown in Census publications have no legal status.* They are used by us solely for statistical purposes."

In direct contrast with the foregoing paragraph is the statement of the Librarian of Congress that the Bureau of the Census is the only authority at present for figures concerning the area of the United States and of the individual states.

The director of the American Geographical Society, speaking for himself, not in behalf of the society, agrees that from the jurisdictional point of view the waters of the Great Lakes within the international boundary should be considered as part of the United States, and their areas assigned to the several states of which they are a part, and that the Census Bureau would have done well to have made this clear.

Canada and Ontario find nothing to prevent the inclusion of their share of the Great Lakes in their total area figures.

Benjamin Franklin fought and defeated France, Spain and England, in Paris, in 1783, when they sought to set the limits of the United States at the southern shores of these bodies of water; but he has been thwarted now by a generation of statistical geographers in our own country who seem to consider the 60,000 square miles of American-owned Great Lakes water nothing but a general nuisance, who have discounted and discredited it, and even disregarded it completely.

This water right now is bearing the most important traffic in the world. Save for the iron ore which must pass over our Great Lakes, the Allied Nations could hold up their hands in complete surrender. Compare the value of this region—now excluded by arbitrary dictum from the total area figures of the Great Lakes States and the United States—with the hundreds of thousands of useless acres of land which are counted in the area of other states such as Texas.

The press of Michigan and Wisconsin has strongly advocated the correction. The best legal opinion in the country says that the case for the Great Lakes States is clearly proven and unanswerable. The Committee on Constitutional Revision in Michigan will include the accurate total area of Michigan in the new constitution of that state.

The Bureau of the Census can correct the situation in the world's reference books by a simple revision of its major area table. Sooner or later this will have to be done.

Meanwhile every one concerned with accurate knowledge rather than the exigencies of statistics will wish to correct his atlas as follows:

TOTAL AREA IN SQUARE MILES

Illinois	57,926 (land,	55,947; water,	1,979)
Indiana	36,519 (land,	36,205; water,	314)
Michigan	96,791 (land,	57,022; water,	39,769)
Minnesota	86,280 (land,	80,009; water,	6,271)
New York	53,203 (land,	47,929; water,	5,274)
Ohio	44,679 (land,	41,122; water,	3,557)
Pennsylvania	46,068 (land,	45,045; water,	1,023)
Wisconsin	66,216 (land,	54,715; water,	11,501)
UNITED STATES ..	3,082,809 (land,	2,977,128; water,	105,681)

CHASE S. OSBORN
STELLANOVA OSBORN

SAULT STE. MARIE, MICH.

MISUSE OF THE TERMS "CLASS DISTINCTION" AND "DEMOCRACY"

PROFESSOR MAST'S letter on page 465 of the May 21, 1943, issue of SCIENCE misuses these two terms. Regardless of its validity, no recognition of outstanding ability can properly be called "class distinction." Certainly no one should think that a democracy implies a group of individuals either having absolutely uniform ability or a pretense at such uniform ability such as would be implied by the elimination of all marks of recognition for outstanding ability. A literal and logical acceptance of the plea to eliminate "starring" of names in the biographical directory of American Men of Science would mean the abolition of all honorary societies, all medals and awards, and, in fact, all recognition of outstanding ability and achievement.

The means by which "stars" are awarded in the various editions of the biographical directory may not be perfect, but it is probably the most "democratic" method by which any recognition of outstanding achievement may be determined.

As to a referendum on "starring" scientists, I would hazard the guess that while many of those with "stars" might vote against the system there would be an overwhelming majority in favor of the system from those not so "decorated."

FRANK C. WHITMORE
STATE COLLEGE, PENNSYLVANIA

THE DISCOVERY OF "STARS"—A PRESENT PROBLEM

I HAVE been interested in the discussion of the "stars" in SCIENCE, believing that such discussion is wholesome. I have heard of Americans being called "dollar chasers" abroad, and I have seen "money grubbers" myself and I have assumed that a broader American culture would supply a wider variety of goals for man to strive for. Hence I have seen no harm in prizes, academic honorary degrees, societies with honorary memberships and even those with qualified membership, since they are supposedly awarded for personal merit. Every one will recognize that a quiet Willard Gibbs might in any generation be overlooked by an Academy of Sciences in its elections. Nevertheless, the peers of such a Willard Gibbs should be the best qualified to locate the "stars" of their generation.

It is of great benefit to the public that the star is located because (1), his productivity may thereby be enhanced, either by the encouragement or by increased facilities afforded; (2) his work may be more certainly preserved for posterity; (3) their results may be utilized, and his work used for the emulation of others.

It is not a question of personal vanity at all. It is not a matter of concern whether the ancestors of Gibbs came over on the *Mayflower* or were aborigines. It is rather what he did, how well we can use those results and what we can learn from his life. Mozart, Schubert and Poe were indeed stars, but it is difficult to believe that neglect on the part of the public of their period made them great. On the other hand, we instinctively feel that our neglect caused the loss of invaluable treasures of music and art.

It is a matter of merely enlightened self-interest for society to seek out a Wallace Carothers and afford him the most suitable surroundings for his genius to work in. How to do that is a problem that science may well ponder.

EUGENE C. BINGHAM

SCIENTIFIC BOOKS

VIRUS DISEASES

Virus Diseases. By Members of the Rockefeller Institute for Medical Research, THOMAS M. RIVERS, W. M. STANLEY, L. O. KUNKEL, R. E. SHOPE, F. L. HORSFALL, JR., PEYTON ROUS. Ithaca, N. Y.: Cornell University Press. 1943. $2.00.

THE title of the volume suggests a text-book. In the technical sense this is far from the case but, in content, a more illuminating insight into experimental thinking could scarcely be devised. The book comprises the Messenger Lectures on the Evolution of Civilization delivered by six members of the Rockefeller Institute at Cornell University in the spring of 1942, said lectures having "the special purpose of raising the moral standard of our political, business, and social life." Although each lecturer deals with specific aspects of the virus problem in which he has been engaged, the composite view is a varied approach to the broad biological problem of the nature of viruses and their modes of action.

In the first of the series, "Virus Diseases with Particular Reference to Vaccinia," T. M. Rivers reviews the concerted efforts to characterize vaccine virus by analysis of its antigenic, physical and chemical properties. Following the principles which have yielded such valuable information of bacterial action, the newer methods of immunochemistry, biochemical assay, enzymatic identification and physical measurements, have been employed by associates and collaborators of special skills with the result that many properties of vaccine virus in the form of elementary bodies have been determined. The manifold attack has revealed a multiplicity of antigens and the presence of chemical substances such as biotin and flavin which suggest the animate nature of the virus; it has also disclosed limitations in the interpretation of homogeneity on the basis of centrifugal or electrophoretic boundaries. The whole story is highly instructive and attractive reading.

Under the title of "Chemical Structure and the Mutation of Viruses," W. M. Stanley tells of the attempts in his laboratory to induce mutants or variants of tobacco mosaic virus by chemical alterations of the virus protein. Having determined that certain strains of the virus differed in their content of certain amino acids, it was suggested that the variations in behavior were related to these differences. Accordingly, virus chemically modified by extensive coverage of the amino and phenol groups was inoculated onto susceptible plants in the hope that the virus produced in the infected plant would resemble the modified material. This was not the case; the resultant virus was similar in nearly all respects to the usual tobacco mosaic virus; however, it was found that the virulence of the virus for a different host was decreased. Chemical treatment beyond a certain point destroyed activity. The studies represent the beginning of a stimulating approach to the fundamental problem of biological variation.

The need for transmission of the agent of an infectious disease of man to new hosts in order to study it adequately is obvious. It may come as a surprise to many that great advantages accrue to the same procedure in the investigation of virus diseases of plants. L. O. Kunkel in the lecture, "New Hosts as a Key to Progress in Plant Virus Disease Research," gives numerous examples of the benefits to be gained: the recognition of unsuspected mixed infections, the attenuation or exaltation of a virus, the appearance of otherwise unexpected properties, and the transfer to new hosts by way of an intermediate plant host, are some of them. The latter procedure has recently proved a notable success in the transfer of viruses which previously had been transmissible only by grafting. The lecture contains numerous implications of importance to the entire field of infection and adaptation.

The attention of investigators of virus diseases has been constantly attracted to Shope's studies of swine influenza. The first part of the present lecture is devoted to reviewing the history and earlier studies leading to the identification of the complex virus-bacterial nature of the disease. The remainder deals with the problem of the origin of epizootics and the residence of the virus in interepizootic periods. A summary is given of the evidence that the virus in masked form is maintained in the lung worms from infected hogs through their developmental cycle in the intermediate earthworm host and back to residence in the lungs of normal swine where proper stimuli serve to activate the virus and incite infection of the animal. The thesis clearly provides a reservoir and an explanation for the sudden reappearance of the disease in wide areas after many months of absence. The analogies and implications for human disease are discussed. In this instance again, the ingenious and skilful experimentation of the investigator are disclosed in relation to a concept, the significance of which extends beyond the biological confines of the disease primarily discussed.

In his discussion of "Human Influenza," F. L. Horsfall, Jr., considers the problem in its broad clinical sense of a symptom-complex which may be of divergent etiology and identified in terms of its distribution as pandemic, epidemic or endemic influenza. The major portion of the discussion deals with the epidemic disease, the etiology of which has been recognized in recent years. An extremely valuable review of the widespread studies is made, especially those concerned with the factors influencing resistance and the efforts toward prophylactic vaccination in which the author has been particularly interested. Critical evaluation is given of certain debated but hypothetical points. This lecture necessarily differs from others of the series in that it is concerned with the broad problem of a disease rather than detailed consideration of specific mechanisms.

The final lecture of the series, "Viruses and Tumors," is by Peyton Rous. In this, for the first time, he summarizes his views on mammalian tumors derived under a variety of influences. The clarification of the differences between the effects of viruses and chemical carcinogens is especially valuable, pointing out the *actuating* effect of the viruses in that each induces a specific type of tumor, whereas, the type of tumor evoked by the carcinogens is primarily dependent upon the natural tendencies of the host and the nature of the tissue to which the material is introduced. Further, the relation of viruses to chemical tumors, to the milk influence and to cancerous changes is presented. It is an important consideration of numerous aspects of a highly controversial subject, dealing as the author does with the biological mechanisms involved. Undoubtedly dissenting views will be expressed.

In conclusion, the purpose of this review has not been to find fault. Blunt criticism can be made of nearly any lecture for the absence of proof for ideas or the lack of interpretation of other data. Nevertheless, the purposes of a lecture are to present a point of view, correlative information and interpretations in an interesting manner. The present volume fulfills these functions to such an extent that it is highly recommended as provocative reading to biological investigators at large.

THOMAS FRANCIS, JR.

UNIVERSITY OF MICHIGAN

STELLAR SPECTRA

An Atlas of Stellar Spectra with an Outline of Spectral Classification. By W. W. MORGAN, PHILIP C. KEENAN and EDITH KELLMAN. Chicago: The University of Chicago Press. 35 pp. 2 figs. 55 photographic reproductions. 1943. $10.00.

THE "Atlas of Stellar Spectra," by Morgan, Keenan and Kellman, has for some time been awaited with keen anticipation by astronomers engaged in the practical problems of spectral classification and the determination of absolute magnitudes. At first sight it seemed rather disappointing that the text accompanying the beautiful atlas should be limited to a descriptive outline of the classification system, without any discussion of the diverse criteria employed elsewhere; and without any analysis of the astrophysical implications. An examination of the contents, however, proves the wisdom of the omissions. Such detours might incite astrophysical discussion more than the practical application which is the unique primary purpose of the Atlas.

The objective of the work has been to set up a system of classification that would be as precise as possible and that could be applied to stars of the eighth to tenth magnitudes with good systematic accuracy. This objective required a two-dimensional system: the usual coordinate correlated with temperature and the new coordinate representing the absolute luminosity. The luminosity classification introduced (in terms of groups Ia, Ib, II–V) is as arbitrary as the usual spectroscopic classification: the luminosity is simply implied in this case, as temperature was implied in the other. The procedure of classification suggested is (1) the determination of an approximate spectral class (in the usual sense); (2) determination of the luminosity class, and (3) the derivation of a more accurate spectral class by comparison with a sequence of stars in the same luminosity class. Here the emphasis is somewhat different from that ordinarily encountered: we have been accustomed to hearing astronomers call for more accurate spectral classes in order that the subsequently determined absolute magnitudes might be more accurate; here, on the other hand, the luminosity classes are necessary in order to improve the spectral classes themselves. The two problems, of course, can not be solved independently, since all the spectral lines vary to some extent both with temperature and luminosity. Thus a few successive approximations are needed for their satisfactory solution.

The Atlas itself, consisting of 55 superb photographic reproductions of Yerkes spectrograms, is an exemplification of a purpose well achieved. First, sequences of spectra illustrate the fundamental progression of spectral class for stars of the main sequence. Then, for stars of the same spectral class, the variations with luminosity are illustrated. Finally groups showing the variation of spectral class among stars of various other luminosity groups (*e.g.*, giant or supergiant) are added. Although emphasis is placed on the more common classes of stars—one of the major purposes of the proposed system of classifi-

cation being its application to the statistical discussion of the distributions of stars—many peculiar objects are also illustrated and briefly discussed. Thus the entire array of prints is well selected to cover the great majority of problems and obstacles that the student of stellar classification is apt to encounter.

In general the criteria adopted by the authors are qualitatively in accord with the criteria Miss Annie J. Cannon employed for the massive Henry Draper Catalogue. Often the actual lines used in the two instances differ, while the elements represented are the same. There are, however, some marked discrepancies, the most conspicuous being in the utilization of the K-line of ionized calcium, which played a heavy role in all Miss Cannon's work but is not employed at all in Morgan, Keenan and Kellman's Atlas. Stars (mainly of the A and early F-types) classified on the new system will consequently show conspicuous systematic deviations from the Henry Draper system. This problem of the classification of the A- and F-type stars has arisen often before in this field of investigation. The criteria used for these classes at Mount Wilson and at Harvard, for example, have been conspicuously discordant, the Mount Wilson observers preferring to base their estimates on comparatively faint metallic lines rather than on the strong calcium line. The problem arose in the first place apparently because the K-line was ill placed at the weak violet extremity of the Mount Wilson spectra, whereas the fainter lines used at Mount Wilson do not show up well on the extremely small dispersion employed for the bulk of the Henry Draper Catalogue. Morgan's Yerkes spectra appear to represent a spectral purity in between the other two, and hence have the practical advantage of effecting a compromise between the faint apparent magnitudes accessible with the Harvard small dispersion objective prism spectra, and the detail and accuracy obtainable from the Mount Wilson equipment.

The descriptions of the various peculiar groups of A–F stars will unquestionably be helpful to other investigators. These stars can be arranged not only according to the temperature and luminosity classes; but numerous sub-groups exist which, from the abnormal intensities of certain lines, have been called silicon, strontium, manganese or metallic-line stars. To the last group, particularly, belong the problematic stars that are assigned to appreciably different classes when different criteria are employed. During work in progress by the reviewer, on the sub-classification of bright stars, two spectral classes are now being recorded for such stars. In extreme cases the discrepancy may amount to a whole spectral class. Although the proportion of stars with ambiguous spectral classes is small, the actual number is evidently too great to be ignored in problems of classification. Earlier work by Dr. Morgan paid much attention to the A stars, and his judgment on which criteria are most suitable, *i.e.*, best correlated with temperature, should be given high weight.

The authors stress the fact that the Atlas has been constructed from slit spectra having a dispersion of about 125 Ångstroms per millimeter. (The reproductions have been enlarged to about 8Å/mm). Just which criteria are most desirable and adequate for the determination of systematically accurate spectral classes depends very appreciably on the dispersion and purity of the spectrograms obtained. Very many of the criteria adopted at Victoria or Mount Wilson, for example, are unsuited to the small dispersion Yerkes spectrograms. Several of the spectral lines included among the Yerkes criteria, on the other hand, are too weak for the smaller dispersion objective prism spectra that Miss Cannon had used. Many of the Yerkes criteria outlined and illustrated appear admirable for the much larger-dispersion objective prism spectra (45Å/mm) used in similar work by the reviewer. Others of the Yerkes criteria, however, are not suited to these larger-scale photographs, because the pairs of lines easily compared in small dispersion are too far separated or situated where background differences in photographic density make intercomparisons awkward. Numerous instruments throughout the country (including those at Harvard) are, however, equipped to yield spectra for which the criteria given in the Atlas are admirably suited.

It is a pleasure to know that this much-needed guide to two-dimensional spectral classification is now available, and to recommend it not only to those who will use it as a research tool, but likewise to teachers who frequently need first-rate illustrations of typical spectra and of absolute magnitude effects. Moreover, the Atlas should go far toward bringing about a desirable greater uniformity in stellar classification in the future.

DORRIT HOFFLEIT

SPECIAL ARTICLES

OBSERVATIONS ON THE NATURE AND PROPERTIES OF THE FLUORESCENT FACTOR F_2[1]

THE accompanying publication of Huff and Perlzweig[2,3] prompts us to make the present report.

[1] From the Department of Pediatrics of the Johns Hopkins University and the Harriet Lane Home of the Johns Hopkins Hospital, Baltimore, Maryland.

[2] J. W. Huff and W. A. Perlzweig, SCIENCE, 97: 538, 1943.

Purified preparations of F_2 more than 100 times as potent in fluorescent units as the original permutit eluates[4] have been obtained from human urine by procedures to be published shortly. The final product is a waxy yellowish brown solid which has been crystallized. It is free from niacin, as judged by a negative immediate cyanogen bromide reaction, but possesses biological properties similar to niacin. One hamster rendered moribund on a niacin-free diet was restored to normal behavior within two hours after oral administration of purified F_2. Purified F_2 is a powerful bacterial growth catalyst for *E. coli* and *H. influenzae*.[5] F_2 occurs in the urine of animals that do not require niacin in their diet (pigs; rats); it occurs in many rat tissues, notably in the liver.

Purified F_2 is readily extracted by butyl alcohols only from alkaline solutions, which explains our observation[6] that alkalinization of urinary eluates was necessary before butyl alcohol extraction to obtain F_2 fluorescence. In acid, neutral or weakly alkaline solutions F_2 exhibits its characteristic fluorescence[7]; with strong alkali fluorescence becomes more greenish. This change is reversible on the addition of acid. On standing with alkali fluorescence gradually fades and a yellowish color develops, changes which are irreversible. F_2 oxidizes slowly in the air, more rapidly in the presence of alkali and $K_3Fe(CN)_6$; the characteristic blue fluorescence is lost and a violet fluorescence develops. This change is irreversible. Addition of acetone to alkaline F_2 solutions produces an intense yellow solution with a green fluorescence resembling that of uranium glass; this change is irreversible. Sulfanilic acid produces an orange red color with loss of fluorescence.

F_2 appears to be a pyridine compound. On alkaline hydrolysis a positive cyanogen bromide test[8] is obtained, not present originally. F_2 is destroyed rapidly by HNO_2.

Since our original communication[4] we have investigated various other pyridine derivatives and wish to report that none of the following can be identified with F_2: cozymase, dihydrocozymase, desaminocozymase, nicotinamide nucleoside and acetyl nicotinamide. We have for some time been familiar with the physical and chemical similarity between F_2 and the N-methyl reduction products of nicotinamide studied by Karrer *et al.*,[9] and had embarked on a program of preparing and testing these compounds when the communication of Huff and Perlzweig was sent to us. Our results to date indicate that one of the dihydro-N-methyl nicotinamides is indistinguishable from F_2 by its adsorption properties, solubility in eleven organic solvents and its reactions with alkali, $K_3Fe(CN)_6$, HNO_2, acetone and sulfanilic acid. We do not feel justified in identifying F_2 as an N-methyl dihydronicotinamide for three reasons: (1) because one of the N-ethyl isomers likewise possesses these identical properties; (2) because acetylation of F_2, of N-methyl and of N-ethyl dihydronicotinamide gives compounds with different fluorescent properties and solubilities; and (3) because the absorption spectrum of F_2 shows characteristic differences.[10]

VICTOR A. NAJJAR
DWIGHT B. MCNAIR SCOTT
L. EMMETT HOLT, JR.

THE PROBABLE IDENTITY OF NAJJAR AND HOLT'S FLUORESCENT SUBSTANCE, F_2

THE following observations are presented to show the similarity in biological and chemical behavior of N-methyl nicotinamide and F_2, the substance described by Najjar and collaborators,[1,2] as appearing in the urine in small amounts normally, and in large amounts after the ingestion of nicotinic acid derivatives.

N-methyl nicotinamide chloride, Fig. 1, was prepared essentially by the simple method given by Karrer.[3] A concentrated solution of F_2 in 25 per cent. KCl solution was prepared from urine obtained from human subjects after large doses of nicotinamide, by the original methods[1,2] and slightly modified by us. A comparison of the biological and chemical behavior of the two substances follows:

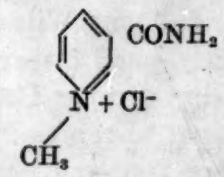

FIG. 1

Animal species which are known to methylate nicotinic acid, man, dog, rat, excreted F_2 in large amounts after doses of nicotinamide. In the rat, which synthesizes nicotinic acid and excretes it largely as tri-

[3] Kindly shown to us in manuscript.

[4] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[5] These observations were made in collaboration with J. H. Hill and H. D. Zepp.

[6] V. A. Najjar and L. E. Holt, Jr., SCIENCE, 93: 20, 1941.

[7] V. A. Najjar, H. J. Stein, L. E. Holt, Jr., and C. V. Kabler, *J. Clin. Invest.*, 21: 263, 1942.

[8] We are indebted to Dr. Harold J. Stein for these determinations.

[9] P. Karrer, G. Schwartzenbach, F. Benz and U. Sollmsen, *Helvet. Chim. Acta*, 19: 811, 1936.

[10] We are indebted to Dr. N. H. Coy for these measurements.

[1] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[2] V. A. Najjar and L. E. Holt, SCIENCE, 93: 20, 1941.

[3] P. Karrer, G. Schwartzenbach, F. Benz and U. Sollmsen, *Helv. Chim. Acta.*, 19: 826, 1936. See also O. Warburg and W. Christian, *Biochem. Zeits.*, 287: pp. 314 *ff*, 1936, for an important discussion of N-methyl nicotinamide as a model for the active component of the reversibly reducible pyridine coenzymes.

gonelline,[4] we found that on a nicotinic acid-free diet F_2 excretion parallels closely the excretion of trigonelline (Table I). Removal of protein from the diet caused a sharp drop in the excretion of both F_2 and trigonelline. The rabbit, which is known not to methylate nicotinic acid to trigonelline,[5] excretes no F_2 after a dose of 250 mg of nicotinamide.

TABLE I

TRIGONELLINE AND F_2 EXCRETION IN RATS

	Trigonelline	F_2	*Diet*
Rat	/day	Units per day	
1	97	32	23 per cent. protein
2	148	136	23 per cent. protein
3	227	288	23 per cent. protein
	31	66	Protein free
4	433	695	23 per cent. protein
	100	201	Protein free

N-methyl nicotinamide and F_2 were found to be adsorbed on and eluted from permutit under the same conditions from urine, and from pure solutions.

Both are extractable by butanol from alkaline KCl solutions and not from neutral or acid solutions. The fluorescence intensity of both is much greater in butanol than in aqueous KCl solution. Colorless aqueous solutions of both, when treated with dilute KOH at ordinary temperatures, become yellow and are reversibly decolorized on acidification. Butanol extracts of the yellow alkaline solution, under a Wood screened ultraviolet light, show green fluorescence which changes reversibly to blue on acidification. The above green fluorescence increases to a maximum in about 20 minutes. Both substances when heated with strong alkali also yield yellow solutions which are not decolorized on acidification. Butanol extracts of these yellow alkaline solutions show blue fluorescence which disappears on acidification and is restored on alkalinization. Hydrolysis of both substances in dilute aqueous HCl or KOH results in a greatly decreased fluorescence in their butanol extracts. This type of hydrolysis is known to convert the amide to the acid, or the N-methyl nicotinamide to trigonelline. Trigonelline also shows a very weak fluorescence under the above conditions.

Since the usual procedure for estimating trigonelline in urine[6] involves its hydrolysis to nicotinic acid with strong alkali in presence of ammonia (or urea), and since this treatment also converts both F_2 and the methyl nicotinamide to nicotinic acid, it is obvious that the previously published values for trigonelline in urine include substance F_2 in addition to true trigonelline.

Thus a normal adult who ingested 200 mg of N-methyl nicotinamide excreted in the urine in 48 hours F_2 equivalent to 55 mg of the original compound, as measured by its fluorescence, plus 85 mg of trigonelline.

From the urine of a normal adult, excreted in 20 hours after the ingestion of 750 mg of nicotinamide, we isolated a crystalline product as the picrate salt. The melting point of this product was 189.5° C (uncorr.) as compared with the melting point of the picrate of synthetic methyl nicotinamide which was identical, 189.5°, and the mixed melting point was unchanged. The picrates of the natural and of the synthetic products decomposed in dilute acid and after removal of the picric acid with ether, yielded quantitatively the identical amount of fluorescence in the ultraviolet, when measured in the usual way for F_2.

F_2 thus appears to be a N-methyl nicotinamide or a labile precursor which yields this compound in the course of isolation. Further work on the chemical identification of this compound and on its metabolic behavior is in progress.

JESSE W. HUFF[7]
WILLIAM A. PERLZWEIG
DEPARTMENT OF BIOCHEMISTRY,
DUKE UNIVERSITY SCHOOL OF MEDICINE

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

POLYVINYL ALCOHOL: A MEDIUM FOR MOUNTING AND CLEARING BIOLOGICAL SPECIMENS[1]

LUBKIN and Carsten[2] have recently reported on the use of polyvinyl alcohol, or PVA, in a method for the elimination of dehydration in histological technique. It is the purpose of the present note to report the use of PVA as a medium for the mounting and clearing of biological specimens.

PVA, a synthetic polymer of vinyl alcohol, is available through the E. I. du Pont de Nemours Company, R. & H. Chemical Department, Niagara Falls, New York. It may be purchased at low cost (less than $1.00 a pound) in pound lots or more.

[1] The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of The Rockefeller Foundation.

[2] SCIENCE, 95: 633, 1942.

The substance is obtained either as a light white powder or as amorphous granular material. It is soluble or dispersible in water, making a clear solution, syrupy in consistency. The viscosity of this solution can be varied by the amount of material added. PVA is not soluble in any of the ordinary fat solvents. The watery solution, upon drying, leaves a transparent, tough, thin film which adheres closely to a grease-free surface. This film is resistant to dampness, water (except immersion for a period of several hours), alcohol, ether, xylol, acetone and other solvents.

The stock solution is prepared by adding PVA (Grade RH-349) powder slowly to cold water, stirring it in thoroughly. The powder goes into solution with difficulty, but the process can be hastened by heating in a steam bath until the solution becomes about as viscous as thick molasses. At this time the solution appears milky, owing to the inclusion of small air bubbles. Upon further heating, or if left to stand for several hours, it becomes water clear. Any undissolved material can be strained off. The stock can be stored and preserved indefinitely and diluted with water to any consistency desired.

Several uses have been found for this stock solution. Giemsa stained blood films, both thin blood films and thick drops, have been preserved by spreading a thin film of stock solution over the stained portion and drying this quickly. Slight fading takes place before the solution dries completely, but after it has dried, such slides, placed even in direct sunlight or under ultra-violet lamp, will not lose any further color. The blood films are covered by a tough, thick film and after examination with oil the oil can be wiped off with a cloth with no possibility of damaging the smear. Slides examined two years after preservation by this method are still in excellent condition.

The stock solution has also been found useful for the examination of mosquito larvae. Live larvae are placed on two or three drops upon a slide. The larvae are quite firmly held by the viscous solution and can be examined most minutely for as long as half an hour. Upon completion of examination the larvae can be washed off into a container of water and soon recover. Smaller living organisms such as trematode cercariae may be placed in a drop of the solution and covered with a cover glass, following which they can be examined under oil immersion for twenty or thirty minutes before they die. This method also works well for detailed examination of motile microorganisms.

A clearing and mounting medium has been prepared by a modification of the original lacto-phenol medium which has the composition of glycerine 60 per cent., phenol 20 per cent., lactic acid 20 per cent. by volume. The original medium clears certain types of material satisfactorily but remains liquid and has to be sealed in, a very time-consuming procedure. We have prepared a somewhat similar preparation which we call polyvinyl-lacto-phenol: PVA stock solution 56 per cent., phenol 22 per cent., lactic acid 22 per cent. by volume. The resulting medium readily clears small objects removed directly from aqueous solution. Mosquito larvae can be satisfactorily mounted by dropping live larvae on to slides, draining off the water, adding 4 to 6 drops of PVA lacto-phenol and covering with a cover glass. More mounting medium should be added if necessary, so that a small amount of the medium flows out on all sides of the cover slip. In two days the cover slip will be cemented firmly in place and the larvae well cleared. In some cases it is necessary to add more medium later if it recedes under the cover slip while drying. Such mounts preserve all details necessary for identification.

A very satisfactory technique has been worked out for the mounting of the terminalia of male mosquitoes. The terminalia, after being cleared in 10 per cent. potassium hydroxide and stained with acid fuchsin, are dissected in a drop of PVA lacto-phenol. The viscosity of the solution aids dissection. The dissected parts can be transferred to a very small drop of solution on a clean slide and arranged as desired. The slide can then be dried in an incubator or on a hot plate so that the parts are firmly held in place in the dried film. A drop of mounting medium is then placed on a cover slip and the preparation covered. This method is rapid and simple.

The method also offers a quick and satisfactory means of mounting pollen grains for measurement and detailed examination and gives a permanent mount.

I should like to thank the E. I. du Pont de Nemours Company for the supply of PVA used and for information about its properties.

WILBUR G. DOWNS,
1st Lieutenant,
Medical Corps, U.S.A.

OFFICE OF THE MALARIA SURVEY,
COLONIAL HOSPITAL,
PORT OF SPAIN,
TRINIDAD, B. W. I.

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